SMART METER-TNB DUAL TARIFF FOR DOMESTIC APPLICATION

NASYRAH BT ABDUL RAHIM

This thesis is submitted as partial fulfillment of the requirements for the award of the Bachelor of Electrical Engineering (Power Systems)

Faculty of Electrical & Electronics Engineering
UniversitiMalaysia Pahang

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ABSTRACT

Presently, the usage of electricity is not balanced between day and night. High demand from industrial, commercial and even residential at day time contributed to extra power generation by Tenaga Nasional Berhad (TNB). Some of these generations' resources, such as coal need all-time non-stop burning process. Due to this, there will be some wastage of energy at night time. This study proposes dual tariff electricity for domestic usage. Tariff will be divided into two which is peak time and off-peak time. Off-peak time will have lower tariff compare to peak time. Today, domestic area is using the typical energy meter, which only applicable for single tariff. To apply dual tariff, a new meter should be used; Smart Meter for Dual Tariff. This meter work as same as TNB energy meter, but it displays the energy usage for peak time and off-peak time. There are two LED to indicate peak time and off-peak time. The meter has select button to display important information, either energy usage, bill or tariff. The development of the meter consists of the reverse-engineering of typical energy meter, the separate energy accumulation for peak and off-peak and the display as interface.

ABSTRAK

Pada masa ini, penggunaan elektrik adalah tidak seimbang antara siang dan malam. Permintaan yang tinggi daripada industri, komersil dan kediaman pada siang hari menyumbang kepada penjanaan kuasa tambahan oleh Tenaga Nasional Berhad (TNB). Beberapa sumber penjanaan elektrik, seperti arang batu memerlukan masa proses pembakaran tanpa henti. Oleh yang demikian, terdapat pembaziran tenaga pada waktu malam. Kajian ini mencadangkan dua tarif elektrik untuk kegunaan rumah sahaja. Tarif akan dibahagikan kepada dua yang merupakan masa puncak dan masa luar puncak. Masa luar puncak akan mempunyai tarif yang rendah berbanding dengan masa puncak. Hari ini, kawasan perumahan yang menggunakan meter tenaga tipikal yang hanya berfungsi bagi tarif tunggal. Untuk mengaplikasikan dua tarif, meter baru harus digunakan; *Smart Meter for Dual Tariff*. Meter ini berfungsi sama seperti meter tenaga TNB yang biasa, tetapi ia memaparkan penggunaan tenaga untuk masa puncak dan masa luar puncak. Meter ini mempunyai butang pilih untuk memaparkan maklumat penting, sama ada penggunaan tenaga, bil atau tarif. Proses pembuatan meter ini terdiri daripada proses kejuruteraan terbalik dari meter tenaga tipikal, pengumpulan tenaga yang berasingan bagi puncak dan luar puncak dan paparan sebagai penghubung.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Current Issue

Electricity in Malaysia was managed by TenagaNasionalBerhad(TNB) alone. Electricity in Malaysia can be divided into five which is industry, domestic, commercial, public lighting and mining and agricultural[1].

Figure 1.1:Single phase electronic kWh energy meter

For domestic application, TNB implement typical electricity meter or energy meter to all houses. Energy meter or electricity meter as in Figure 1.1is a basic meter that will calculate,display and record electrical energy consumed by user per month in terms of kWh unit [2].

Table 1.1 : Domestic Tariff in Malaysia

Domestic Tariff		
	Unit	Rates
For the first 200 kWh (1-200 kWh) per month	sen/kWh	21.8
For the next 100 kWh (201-300 kWh) per month	sen/kWh	33.4
For the next 100 kWh (301-400 kWh) per month	sen/kWh	40.0
For the next 100 kWh (401-500 kWh) per month	sen/kWh	40.2
For the next 100 kWh (501-600 kWh) per month	sen/kWh	41.6
For the next 100 kWh (601-700 kWh) per month	sen/kWh	42.6
For the next 100 kWh (701-800 kWh) per month	sen/kWh	43.7
For the next 100 kWh (801-900 kWh) per month	sen/kWh	45.3
For the next 100 kWh (901 kWh onwards) per month *The minimum monthly charge is RM3.00*	sen/kWh	45.4

Table 1.1 show domestic tariff implement by TNB. This tariff is called block tariff.Every month, TNB worker will come to every house to calculate the bill using block tariff[1]. This tariff will cost the customer due to their consumption rates. If their consumption is higher, so the bill will increase and vice versa. This block tariff has no relationship with the time of use of energy. Related to this, consumer can use the electrical energy whenever they want, day or night.

1.2 Problem Statement

Normally, office or commercial customer will start their operation on 8 am until 5 pm. Industries also have same operation hours. Only some industry operates 24 hours.Electrical energy consumption for housing area is higher starting from 6 am until 10 pm. This is due to house cleaning using vacuum and laundry that is usually done during the day. This show that energy consumption during the day is higher than night and this create an imbalanced energy consumption between night, which is off-peak time and day, which is peak time.Due to this, there will be some waste of energy produced by TNB at night.

The way to overcome this problem, dual-tariff system should be implemented to housing area. Dual-tariff is totally different from block tariff that is used by TNB for domestic nowadays. Dual-tariff is a tariff with two rates which is differs by time which is peak time and off-peak time [3]. A rate for peak time is higher than off-peak time rates. Higher rates for peak time will teach domestic customer to reduce the electrical energy consumption during the day and plan to use the electricity during the night.

Dual-tariff system cannot be implemented if domestic area still using energy meter. Smart meter which is compatible for dual-tariff must be design. A meter for dual-tariff already in market, but to be more innovative, this meter will be improved to become smart meter. Basically, of course this meter can calculate, display and record electrical energy consumption over specified period of time for peak time and off-peak time. It is called smart meter because it also can display bill and dual-tariff other than energy consumption.

1.3 Background Study

Actually, TNB already offers dual-tariff rates, but only for industry and commercial customer which operates 24 hours. TNB does not have any short-term planning to convert block tariff to dual tariff system for domestic area.

TNB dual tariff rates that already been used by industries and commercial customer as shown in Table 1.2 will be used for this project.

Table 1.2:Dual tariff rates for Industries

Special Industrial Tariff (for consumers who qualify only)		
	Unit	Rates
For each kilowatt of maximum demand per month during the peak period	RM/kW	27.70
For all kWh during the peak period	sen/kWh	28.3
For all kWh during the off-peak period *The minimum month charge is RM600.00*	sen/kWh	16.1

1.4 Objective

Objective of this project is to :

i. Develop a smart meter that is compatible for dual tariff system.
ii. Propose the usage of dual tariff system for home/domestic application.
iii. Re-balanced the energy usage between day and night.

1.5 Scope of Project

This project will cover :

i. Single Phase Application

ii. Sinusoidal Current

This smart meter only applicable for single phase application. TNB already implement dual tariff for industries which is using three phase meter.

CHAPTER 2

LITERATURE REVIEW

There are many country that already implement dual tariff system or commonly known as time of use tariff (ToU). Time for time-of-use tariff is different from each country, depends on the seasons time.Time-of-use tariff also can become a business strategy for certain country. No matter what reasons time-of-use tariff had been choose, the main cause is time-of-use give benefits to the country and users. Australia, United Kingdom, Canada, South Africa, USA, Spain and Switzerland is a country that already implement time-of-usetariff[3,4,5].

Australia already use time-of-use tariff for housing area[6].In Australia, the user can choose whether time-of-use tariff or single rate tariff depends on the way of energy consumption. If the user think that time-of-use is not suitable with the way of their life, they can choose single rate tariff. It is same for UK, which the system and meter known as Economy 7[7].

Before some changes can be made, a study and survey on acceptance of customer should be made by electrical energy supplier, which is TNB in Malaysia.

This is what Victorian Government do. They still study the impact of time-of-use tariff. Until 2012, time-of-use tariff will not be used in Victoria[6].

Ontario, Canada also implement time-of-use tariff for domestic application, but with three different times, which is off-peak, mid-peak and peak time as shown in Figure 2.1. Other than that, the rates also differ between summer and winter.Special things about Ontario time-of-use tariff is weekends and holidays will be off-peak time[8]. Customer must check the rate of tariff frequently to reduce the bill. It is more easier if the user can read the tariff from the meter because the tariff is always change by time in this situation.

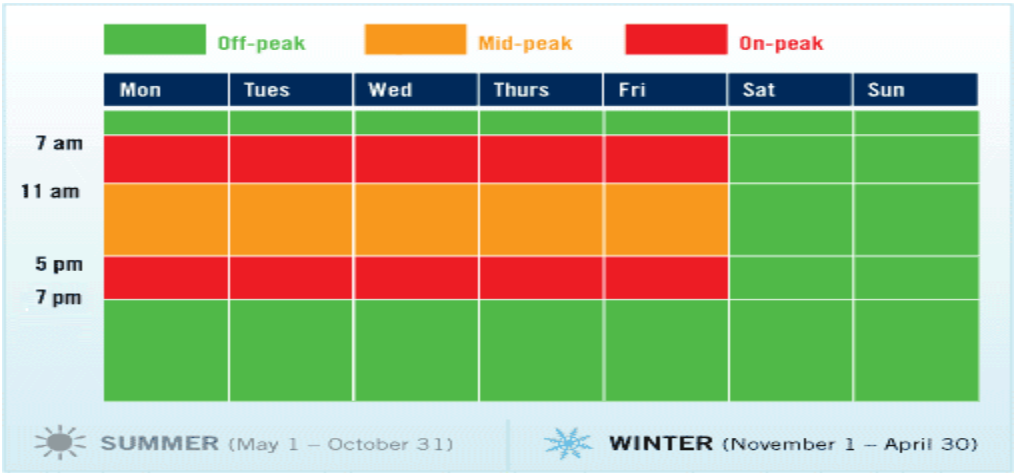

Figure 2.1:Time-of-use tariff in Ontario

Eskom western region, South Africa already carried out a case study on time-of-use tariff to re-balance the usage of energy[9]. The case study shows that electrical energy consumption can be re-balanced using time-of-use tariff.Same situation goes for Spain, which time-of-use tariff was carried out to decrease overcapacity during peak time[10].

In USA, there is an electrical energy supplier known as Baltimore Gas and Electric (BGE) Company used time-of-use tariff as business strategy[11].Only customer that buy electrical energy from BGE company can enjoy the benefit of time-of-use tariff. In Malaysia, TNB is the only electrical energy supplier, so that TNB have no worries about the strategy.

CHAPTER 3

METHODOLOGY

3.1 TNB Meter

TNB have their own requirement for the meter. There are four company build a meter for TNB. One of it is Malaysian intelligent Meters (MiM).All the design purely from TNB. All the meters itself have a sensitivity which no one can open the meter or else the meter will be broken. This action was taken to make sure no one can modify or copy the meter. To make sure this smart meter can fulfill all the requirement from TNB, a real TNB meter is used as illustrate by Figure 3.1. The meter chosen is digital meter for domestic application from MiM as Figure 3.2. This meter will read the current and voltage to calculate power consumption by user. For every 1Wh use, a pulse is produce. People can detect the pulse using the LED indicator. For this project, this pulse will be use as an input for processor to calculate power consumption by user.

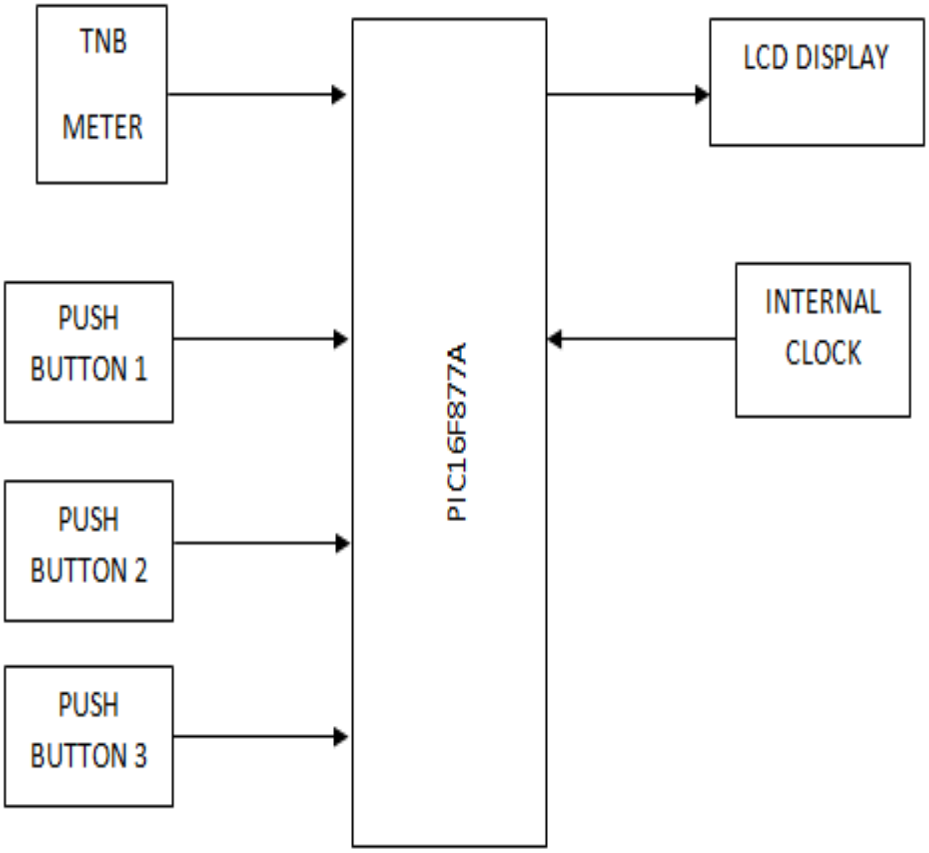

Figure 3.1:Block Diagram for Smart Meter

"I hereby acknowledge that the scope and quality of this thesis is qualify for the award of the Bachelor Degree of Electrical Engineering
(Power System)"

Signature : _____

Name of Supervisor : DR HAMDAN BIN DANIYAL

Date : 21 JUNE 2012

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